

# Dynamics of radioactive cesium in forest-stream ecosystem in a mountainous watershed

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Nine years have passed since the nuclear power plant accident at Fukushima Daiichi Nuclear Power Plant accident, but much radioactive cesium ( $^{137}\text{Cs}$ ) still remains in forests. Given that around 70% of the contaminated area is covered by forest, the fate of radioactive cesium in forest environments is an important topic because of the long half-life of  $^{137}\text{Cs}$  and the complicated forest ecosystem. Especially in manufactured cedar forests,  $^{137}\text{Cs}$  migrates within the linkage of the stream and riparian ecosystems via food web from cedar litter as the primary energy source to the highest consumer of fish. Whereas the  $^{137}\text{Cs}$  contamination is strongly related to both of the stream and riparian ecosystems, most of the previous studies about  $^{137}\text{Cs}$  contamination in forest ecosystems have focused on one ecosystem or some specific species. In this study, we examined the temporal change of  $^{137}\text{Cs}$  concentration in a headwater stream-riparian ecosystem at Towa-region in Nihonmatsu-city, Fukushima, for four seasons during two sampling periods; 2012-2013 and 2016-2017. The  $^{137}\text{Cs}$  concentration significantly decreased among the sampling periods for all the samples; cedar litter from riparian and stream, terrestrial and aquatic insects, and white-spotted char (*Salvelinus leucomaenis*). We also calculated ecological half-lives ( $T_{\text{eco}}$ ), which are indicators of temporal contamination change, including various environmental processes and commonly applied to long-time assessments of environmental radioactive contamination. The calculated  $T_{\text{ecos}}$  were 1.6-3.9 years with the shortest of riparian litter and the longest of stream litter. These  $T_{\text{ecos}}$  were relatively short compared to the previous studies for Fukushima and other contaminated sites, suggesting that headwater ecosystems had faster contamination decrease because of the faster nutrient cycle. Also, the  $T_{\text{ecos}}$  in aquatic components were longer than terrestrial components. It was estimated that  $^{137}\text{Cs}$  contamination in stream ecosystems decreased more slowly than riparian systems since newly supplied litter, less and less contaminated with time, was the only source of contamination in riparian systems. In contrast, fallen litter, as well as resuspension of sediment and POM, kept the contamination in stream ecosystems.

Keywords: radioactive cesium, temporal change, dynamics in the environment, forest ecosystem, watershed management